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ABSTRACT

This unit of instruction deals with a study of the general atmosphere by layers with an emphasis on physical characteristics. The formation of layers in the atmosphere and the energy relationships that exist between them are also discussed. No requisites for prior course work, experience, or courses to be taken concurrently are required for enrollment. The booklet lists the relevant state-adopted texts and states the performance objectives for each unit. It provides an outline of the course content and suggests experiments, demonstrations, guest speakers, field trips, innovative activities, and topics for student projects, discussion questions, and reports. Also listed are relevant films available from the Dade County Audiovisual Center. Reference books are recommended, and a master sheet is provided relating each suggested activity to the specific performance objectives. (JR)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

ATMOSPHERE

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5313.33

SCIENCE

(Experimental)

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DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

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SCIENCE

(Experimental)

Written by Sandra Kay Reese
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1972

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ATMOSPHERE

COURSE DESCRIPTION

A study of the general atmosphere by layers with emphasis on physical characteristics. The formation of layers in the atmosphere and the energy relationships that exist between them are discussed.

ENROLLMENT GUIDELINES

No requisites for prior course work, experience, or courses to be taken concurrently.

STATE ADOPTED TEXTS

1. Earth Science Curriculum Project. Investigating the Earth. Boston: Houghton Mifflin Co., 1967.

2. Thurber, Walter A. and Kilburn, Robert E. Exploring Earth Science. Boston: Allyn and Bacon Inc., 1970.

PERFORMANCE OBJECTIVES

1. Given a list of components, the student will identify those components present in pure, dry air.

2. Given the concept "air has pressure," the student will devise a method to prove the concept.

3. Given a list of atmospheric components and their densities, the student will predict which components may be found in each layer of the atmosphere respectively.

4. Given several different wind reports, the student will deduce the best possible energy exchange that could have caused each particular wind report.

5. Given laboratory demonstrations, the student will determine the energy exchange present in each change of state of water.

6. Given visuals of clouds, the student will identify each as to family name and weather indication.

7. Given a list of types of precipitation, the student will discuss the energy relationships necessary for the formation of each.

8. Given a visual of convection currents, the student will relate the visual to adiabatic temperature change.

9. Given two approaching weather fronts, the student will discuss the sequence of events that will take place due to energy relationships.

COURSE OUTLINE

I. Physical Characteristics of Atmosphere

A. Composition of air

1. Gaseous components of pure dry air
2. Variable gaseous components of moist air

a. Water vapor
b. Ozone

3. Solid components of impure air

a. Dust
b. Smoke
c. Salt crystals

B. Pressures of air

C. Density of air

D. Layering of air: components and density

1. Troposphere
2. Stratosphere
3. Ionosphere
4. Exosphere

II. Energy Exchange by Atmospheric Circulation

A. Exchange of energy between layers of atmosphere

1. Horizontal flow
2. Vertical flow

B. Convection-circulation system

1. Lows
2. Highs
3. Isobars

C. Planetary circulation

D. Wind belts

1. Doldrums
2. Horse latitudes
3. Northeast trade winds
4. Southeast trade winds
5. Polar front

E. Jet stream

1. Location
2. Cause
3. Effects

III. Energy Exchange Through Atmospheric Moisture

A. Water vapor: change of state

1. Evaporation

a. Increased kinetic energy of escaping molecules
b. Cooling process

2. Condensation

a. Loss of kinetic energy
b. Warming process

3. Freezing

a. Greater loss of kinetic energy
b. Liberation of heat of fusion

4. Melting

a. Increase in kinetic energy
b. Heat of fusion must be added

5. Sublimation

B. Water vapor measurement

1. Vapor pressure
2. Relative humidity
3. Dew point
4. Absolute humidity

C. Clouds

1. Formation
2. Types and indications

a. Stratiform - air movement
b. Cumuliform - rising air currents

3. Classes and names

D. Fog

E. Precipitation

IV. Energy Releases in the Atmosphere

A. Air masses

1. Arctic
2. Polar
3. Tropical
4. Equatorial

B. Adiabatic temperature changes

1. Rising of air
2. Sinking of air

C. Weather fronts

1. Definition
2. Development
3. Types

a. Cold
b. Warm
c. Occluded

D. Cyclones and storms

EXPERIMENTS

Thurber, Walter A. and Kilburn, Robert E. Exploring Earth Science. Boston: Allyn and Bacon, Inc., 1970.

1. Rate of evaporation (p. 248)
2. Temperature and saturation (p. 249)
3. Measuring dew point (p. 252)
4. Measuring density (p. 259)
5. Making a cloud (p. 256)
6. Measuring atmospheric pressure (p. 260)
7. Elevation and pressure (p. 251)

Navarra, John Gabriel and Strahler, Arthur N. Our Planet in Space: The Earth Sciences. New York: Harper and Row, 1967.

8. A wind rose (p. 266)
9. Using an anemometer (p. 232)
10. Pressure gradients (p. 234)
11. Coriolis effect (p. 237)
12. Cloud chart (p. 258)
13. Evaporation (p. 262)
14. Using the psychrometer (pp. 267, 268)
15. Cyclonic storm (p. 282)
16. Adiabatic temperature changes (p. 288)

Earth Science Curriculum Project. Investigating the Earth Teacher's Guide Part 1. Boston: Houghton Mifflin Co., 1967.

17. Investigating land and water temperature (Investigation 7-10, p. 209)
18. Investigating evaporation (Investigation 8-2, p. 223)
19. Investigating cumulus cloud formation (Investigation 8-12, p. 242)
20. Investigating weather maps (Investigation 8-13, p. 244)

Hibbs, Albert R. and Eiss, Albert F. Investigating Our Environment: The Earth-Space Sciences. Atlanta: Laidlaw Brothers, 1969.

21. Air currents (p. 348)

Eiss, Albert F.; Buschke, Edward W.; and Hibbs, Albert R. Laboratory Manual for the Earth-Space Sciences. Atlanta: Laidlaw Brothers, 1970.

22. Weather equipment (lab 32, p. 103)
23. Weather fronts (lab 33, p. 107)

DEMONSTRATIONS

Earth Science Curriculum Project. Investigating the Earth Teacher's Guide Part 1. Boston: Houghton Mifflin Co., 1967.

1. Sunset (p. 203)
2. The formation of raindrops (p. 230)
3. Diffusion (p. 231)
4. Gravity flow in fluids (p. 238)

PROJECTS

1. Make a series of color photographs of the sky just after sundown for two or more weeks. Study daily weather maps and explain the differences in the photographs.

2. Produce ozone with a "sterilamp" connecting the lamp to a toy transformer and enclosing the lamp in a bottle. Test the effect of ozone on a culture of bacteria.

3. Measure the dew point of the air in one place at hourly intervals throughout a full day. Make a graph showing the results.

4. Test the effect of humidity on hairs of different size, color, and type. Remove grease from the hair with a strong soap solution.

5. Cover a shallow plate with a thin layer of dessert gelatin. Expose the plate to the air for a day to collect dust. Examine the surface under a microscope to look for grains of pollen. Repeat the study at different times of the day.

6. Make a chart that shows pressures and temperatures of the atmosphere at different altitudes.

7. Make a circle graph showing the composition of pure dry air.

8. Demonstrate the effect of pressure on a balloon. Put a partly inflated balloon under a bell jar and pump out as much air as possible.

9. Keep a record of the time when cirrus, cirrostratus, altostratus and stratus clouds appear in advance of a warm front. Find out how long each type precedes rain.

10. Make detailed notes of conditions before, during, and after a thunderstorm, using sketches to show cloud forms. Write a report explaining the conditions which you have observed.

11. Keep an hourly record of wind velocity and direction while at a beach during a period of good weather. Use graphs to show wind conditions during this period.

12. By allowing a beaker of clear limewater to be exposed to the air in the room for some time, show the presence of carbon dioxide in the atmosphere.

REPORTS

1. Ascents into the stratosphere or beyond by balloon, plane, or satellite.
2. High altitude flights by airplanes.
3. The uses of ozone and the methods by which it is prepared commercially.
4. Blaise Pascal's investigations of atmospheric pressure.
5. Cloud seeding.
6. Interview an airplane pilot about how the shapes of clouds tell him about conditions in the atmosphere.
7. Hail - its description and formation.
8. Atmospheric difficulties encountered in mountain climbing and the methods used to overcome them.
9. The history of the United States Weather Bureau.
10. The Jet Stream.
11. Atmospheric statistics.

FIELD TRIPS AND SPEAKERS

1. American Meteorological Society
   U. S. Weather Bureau
   National Hurricane Research Laboratory
   P. O. Box 8265
   University of Miami Branch
   Coral Gables

2. United States Government
   Department of Commerce
   ESSA

3. United States Government
   Department of Commerce
   Sea Air Interaction - Telephone 350-4191

4. United States Coast Guard
   (Field Trip) Commanding Officer
   A Coast Guard Cutter
   c/o Coast Guard Station
   Miami Beach 33139
   (Speaker) Commander 7th Coast Guard Dist.
   51 S.W. 1st Avenue, Miami 33130

5. News Department
   Channel 7 WCKT
   1401 North Bay Causeway
   North Bay Village
   Miami Beach - Telephone 757-6692
   (Most T.V. stations are extremely co-operative.)

6. Eastern Airlines
   Airport Meteorology Department
   Public Relations
   Telephone 873-6321
   (Small groups preferred.)

7. N.O.A.A.

FILMS
Available from Dade County Audiovisual Center

1. Inconstant Air, The
   AV#1-30373, 29 min., C

2. What Makes Clouds?
   AV#1-11002, 19 min., C

3. What Makes the Wind Blow?
   AV#1-10997, 16 min., C

4. Air in Action
   AV#1-03591, 10 min., BW

5. Atmosphere and Its Circulation
   AV#1-01820, 11 min., BW

6. Atmosphere and Life on Earth
   AV#1-01823, 11 min., C

7. Clouds
   AV#1-02129, 10 min., BW

8. Clouds Above
   AV#1-02135, 9 min., C

9. Earth, The: Its Atmosphere
   AV#1-02124, 11 min., C

10. Life in a Cubic Foot of Air
    AV#1-02196, 11 min., BW

11. Ocean of Air, The
    AV#1-10999, 14 min., C

12. Our Weather
    AV#1-02093, 11 min., BW

13. Reading Weather Maps
    AV#1-10995, 14 min., BW

14. Weather: Air in Action
    AV#1-02112, 8 min., C

15. Weather: Understanding Storms
    AV#1-02128, 10 min., BW

16. What Makes Rain?
    AV#1-02141, 10 min., BW

17. Winds and Their Causes
AV#1-02113, 10 min., BW

18. Air All About Us
AV#1-01816, 10 min., BW

19. Modern Weather: Theory and Structure of Storms: Development and Characteristics of Atmospheric Waves
AV#1-12986, 15 min., BW

20. Up in the Air: Exploring Our Atmosphere
AV#1-04463, 12 min., C

21. Work of the Atmosphere
AV#1-05600, 11 min., BW

22. Air Pollution
AV#1-05858, 10 min., C

23. Air All Around Us
AV#1-05733, 11 min., C

SUGGESTED DISCUSSION QUESTIONS

1. Study a weather map of the United States. Identify areas in which precipitation has occurred. What conditions existed in each of the areas having precipitation? Analyze the data. Can you identify similar trends in each area in which precipitation occurred? How do the conditions vary for each type of precipitation which might fall in an area?

2. Is there a relationship between wind and air pressure?

3. What is happening to warm air in a convection-circulation system?

4. Why does air tend to move from the water to the coast in the daytime?

5. How does the Coriolis effect influence the planetary circulation of winds?

6. In what way does water vapor contribute to the exchange of energy in the atmosphere?

7. What process brings about the release of heat from water vapor?

8. Is there an increase or decrease in kinetic energy when a solid melts? Explain.

9. Which weighs more, dry air or moist air? Why?

10. Does a change of air temperature affect relative humidity? Explain.

11. What happens when the temperature of the air reaches the dew point?

12. Does a gas become cooler or warmer when its confining pressure is reduced? Does molecular motion have anything to do with this temperature change? Explain.

13. What kind of weather is likely to occur within a low? Within a high?

14. What are the ways in which various air masses differ from one another?

15. Study a map of the world. Locate Miami on this map. In which wind belt of the globe is Miami? In general what is our weather like? How would you describe our climate? Are our weather and climate associated with our wind belt in any way? If not, what factors do you think tend to modify our weather and to what extent?

16. Is a particular type of cloud associated with a particular type of weather? Does a particular type of cloud help you forecast weather? Defend your answer.

17. Discuss various sources of dust in the atmosphere.

18. Why is half of the earth's air concentrated in the lower one-third of the atmosphere?

19. What conditions might cause a fog on a mountain top?

20. Why is the sky usually blue? Why is the sky often red at sunrise and sunset?

21. Why does a maritime mass from the Pacific Ocean usually have entirely different qualities after it crosses the Rockies?

22. What is the effect of clouds on incoming solar energy?

23. Why does condensation of water vapor increase the circulation in a convection cell?

24. What is the general direction of movement of temperate zone cyclonic storms?

25. What foretells an approaching warm front?

26. What weather attends passage of a cold front?

27. What causes the winds known as easterlies? What causes westerlies?

ADDITIONAL INNOVATIVE ACTIVITIES

1. Keep a record of weather forecasts given in newspapers or news programs and compare these with the actual weather. Calculate the percentage of correct forecasts.

2. Collect weather sayings, such as, "Red sky at night, sailor's delight; red sky in the morning, sailors take warning." Test some of these to see if they are dependable.

3. Make a chart of the atmosphere showing the levels at which commercial planes fly, altitude records set by planes and balloons, and the orbits of a number of satellites.

4. Measure the water that falls in a straight-sided can during a single rainfall. Calculate the water that fell on a square mile.

5. Set up a mercury barometer inside a large bottle that is closed with a two-hole stopper. Change the pressure inside the bottle and study the changes in the column of mercury. Find out how much air can be removed with a vacuum pump.

REFERENCES

1. Clausse, Roger and Facy, Leopold. The Clouds. New York: Grove Press Inc., 1970.

2. Eiss, Albert F. and Buschke, Edward W. Laboratory Manual for Investigating Man's Environment - The Earth Space Sciences. Atlanta: Laidlaw Brothers, 1969.

3. Hare, F. K. The Restless Atmosphere: An Introduction to Climatology. New York: Harper and Row, 1963.

4. Hibbs, Albert R. and Eiss, Albert F. Investigating Man's Environment - The Earth-Space Sciences. Atlanta: Laidlaw Brothers, 1969.

5. Irving, Robert. Hurricanes and Twisters. New York: Scholastic Book Services, 1961.

6. *Navarra, John Gabriel and Strahler, Arthur N. Our Planet in Space: The Earth Sciences. New York: Harper and Row, 1967.

7. Ramsey, William L., et al. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1969.

8. Stone, Donald B. Discovery Problems in Earth Science - Teacher's Manual. New York: College Entrance Book Co., 1962.

9. Sutton, O. G. The Challenge of the Atmosphere. New York: Harper and Row, 1961.

10. Trewartha, Glenn T. The Earth's Problem Climates. Madison: University of Wisconsin Press, 1961.

*Strongly recommended

MASTER SHEET-- ATMOSPHERE

Objectives	Texts	Laboratory Activities	Speakers Field Trips	Projects	Reports	Demonstrations	Films	Additional Activities	References	Discussion Questions
1	#2. ch. 8		1,2,3,4,5,6,7	1,2,5,7,12	3	1	1,6,9, 10,18, 20,21, 23	2	2,6	17,20
2	#2. ch. 8	6,7,9		6,8	4,8		9,11,18, 20,23	3,5	2,3,4,6,7 8,9	2,5,18
3	#1. ch. 1,8, 27	4	1,2,3,4,5,6,7	6	1,2,8, 10		9,11,18, 20,23	3,5	2,3,4,6,7, 8,9	9
4	#1. ch. 9, 28	8,11,21, 22	1,2,3,4,5,6,7	4,11	9,10		3,4,5, 13,14, 15,17, 19		2,3,4,6,7, 8,9,10	14,15,21,22, 26
5	#1. ch. 8,9, 28	1,2,13, 17,18		3,4		2,3			2,4,6,7,8, 9	5,7,8,11,19, 22
6	#1. ch. 19, 28	5,12,19	1,2,3,4,5,6,7	9,10	6,9,10, 5		2,7,8, 12,13, 14,15, 19	2	1,3,4,6,7, 8,9,10	5,15,16,21
7	#1. ch. 19, 28	1,2,3,13, 14,15,18	1,2,3,4,5,6,7	3,10	7,9,10	2,3,4	12,13, 14,15, 16,19	4	2,3,4,6,7, 8,9,10	1,5,10,11,15, 19
8	#1. ch. 9, 18, 27	16,21	1,2,3,4,5,6,7	11	9,10		3,4,5, 17		2,3,4,5,6, 7.8.9.10	2,3,4,10,15, 21,22,23
9	#2. ch. 7,8, 19	20,22,23	1,2,3,4,5,6,7		9,10		12,14, 13,15, 19	1,2	2,3,4,5,6, 7,8,9,10	1,13,14,15,16, 21,24,25